THE MORTALITY FROM CHILDHOOD TUBERCULOSIS IN SHEFFIELD

POSSIBLE CAUSES OF ITS DECLINE

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The purpose of this paper is to describe the recent decline in tuberculosis mortality in children in Sheffield, to consider some of the factors probably responsible for that decline, and to compare the results in Sheffield with those obtained in Great Britain and her other major cities.

Decline of Tuberculosis Mortality in Children

Sheffield

In 1924, 82 Sheffield children under 15 years of age died of tuberculosis. In the next ten years the number of annual deaths was more than halved, and in 1934 they fell to 29. At this point the improvement was halted, and between 1934 and 1947 no significant reduction occurred. The number of children who died of tuberculosis varied between 25 and 31 in the peace years, but rose higher in the war years and reached a peak of 39 in 1941.

After 1947 there was a dramatic fall in the tuberculosis mortality in children. In 1948 and 1949, 18 children died each year, in 1950 12, in 1951 6, and in 1952 only 2 (Table I). The death rate per 100,000 children

TABLE I.—Annual Number of Deaths from Tuberculosis in Children (0–14 years) in Sheffield, 1924–52

Year	No. of Deaths	Year	No. of Deaths	Year	No. of Deaths
1924	82	1934	29	1944	37
1925	72	1935	28	1945	26
1926	80	1936	28	1946	25
1927	81	1937	31	1947	26
1928	71	1938	31		
1929	58	1939	35	1948	18
1930	53	1940	35	1949	18
1931	40	1941	39	1950	12
1932	44	1942	30	1951	6
1933	38	1943	38	1952	2

under 15 years of age fell from 25 in 1947 to 1.8 in 1952, or 7% of the 1947 figure, representing a 14-fold reduction in five years.

This sharp decline in tuberculosis mortality in children far exceeded both the decline of the overall tuberculosis mortality at all ages and the decline of mortality of children from other causes.

During the period 1934 to 1945 child deaths from tuberculosis amounted to between 7.2 and 10.4% of all deaths from tuberculosis at all ages, the proportion showing a tendency to rise during the war years. In 1947 8.8% of all the tuberculosis deaths in the city occurred in children, which was the same as the average in the three years preceding the war. After that time this proportion fell steadily, and in 1952 child deaths from tuberculosis amounted to only 1.6%. During the same period adult deaths from tuberculosis fell only to 46% of the 1947 figure (Table II).

The importance of tuberculosis as a cause of death in children was particularly evident in the age group 1 to 14 years. In 1944 deaths from tuberculosis in this group amounted to 21% of deaths from all causes, and in the first three post-war years the average annual

TABLE II.—Annual Deaths from Tuberculosis at All Ages and in Children Under 15 Years of Age. Child Deaths as a Percentage of Deaths from Tuberculosis at All Ages. England and Wales and Sheffield

Year	England and Wales			Sheffield		
	All Ages	Children 0–14	Child Deaths (%)	All Ages	Children 0–14	Child Deaths (%)
1934–6*	28,693	2,904	10.4	385	28	7.2
1937–9*	26,297	2,311	8.5	361	32	8.8
1940–2*	27,096	2,527	9.0	371	35	9.4
1943–5*	24,245	2,198	9.0	325	34	10.4
1946	23,388	1,914	8.2	301	25	8.3
1947	23,075	1,955	8.4	294	26	8.8
1948	21,665	1,562	7.2	255	18	7.0
1949	19,721	1,148	5.8	264	18	6.8
1950	15,969	909	5.7	189	12	6.4
1951	13,806	831	6.0	181	6	3.4
1952	10,567	—	—	127	2	1.6

* Triennial figures are yearly averages.

figure was still 16.8%. In these years tuberculosis was second only to accidents as a cause of death. After 1947 child deaths from all causes between 1 and 14 years of age fell to one-half, but, whereas the number of deaths from all causes other than tuberculosis fell to three-fifths, deaths from tuberculosis fell to one-tenth and accounted for only 3.5% of all deaths (Table III).

TABLE III.—Annual Number of Deaths (1–14 Years) from Tuberculosis and All Causes. England and Wales and Sheffield 1944–52

Year	Deaths from Tb		Deaths from All Other Causes		Total Deaths		Tb Deaths as % of All Deaths	
	E.&W.	S.	E.&W.	S.	E.&W.	S.	E.&W.	S.
1944	1,803	32	11,672	120	13,475	152	13.3	21.0
1945–7*	1,716	22	9,084	109	10,800	131	15.9	16.8
1948	1,316	17	7,537	100	8,853	117	14.9	14.5
1949	985	17	7,287	97	8,272	114	11.9	14.9
1950	785	10	6,203	62	6,988	72	11.2	13.9
1951	732	6	6,500	62	7,232	68	10.1	8.8
1952	—	2	—	54	—	56	—	3.5

* Yearly average.

Great Britain

Similar trends in mortality could be observed in England and Wales and in Scotland during most of the period under review. In England and Wales the general tendency of improvement slowed down several years before the war, and between 1935 and 1947 tuberculosis was still responsible for from 2,000 to 3,000 deaths each year, the death rate per 100,000 children being 28.5 in 1935 and 21.4 in 1947. After 1948 the rate of fall became substantially accelerated, and in 1951 831 children died of tuberculosis, the death rate being 8.5 per 100,000 (Table II). The tuberculosis death rate of Sheffield children was consistently higher than that of England and Wales up to and including 1950, but in 1951 the Sheffield rate fell to three-fifths of the national rate, although Sheffield's adult tuberculosis mortality rate was still 12% above the national average. The official tuberculosis mortality figures of children in England and Wales for 1952 have not yet been published. Available unofficial information suggests, however, that in 1952 Sheffield's rate will be about one-third of the national rate.

In Scotland the situation has generally been much less favourable, and in 1947 the tuberculosis death rate in children was 46 per 100,000, compared with 21 in England and Wales and 25 in Sheffield. Since then the position has greatly improved and the mortality rate fell to 16 in 1951 (England and Wales=8.5), and to 10 in 1952 (Table V). This last figure, however, is still more than five times as high as that of Sheffield. In spite of Scotland's much higher mortality rate in 1947, the rate of fall up to 1952 was three times slower than that of Sheffield.

Compared with London and the other major English cities with a total population of over 500,000 and a child population of over 100,000, Sheffield occupied a middle position until 1950. In 1951 Sheffield's tuberculosis mortality rate for children fell below the others, and in 1952 it was between one-fifth and two-fifths that of the other cities. Sheffield's rate was two-fifths that of the combined rate of the six next largest cities with a total population of 280,000 to 500,000 and a child population of 60,000 to 100,000, and was below that of any one of them (Table IV). Among

in Sheffield. Among the possible factors were a change in the natural course of the disease, which may have taken on a more benign form; the effect of favourable trends in the environment; the effect of more efficient treatment; and, finally, the effect of active measures to eradicate the disease. Unknown factors may also have played a part.

Changes in the natural history of the disease in a short space of five years could only be minimal, and this factor need not be considered further.

Socio-economic Factors

It is difficult to estimate the influence of the changes in the living standards of the population. There is no evidence, however, that in the last five years the standard of living has risen to any great extent. The diet of the community was remarkably constant, the level of employment was uniformly high, but the housing conditions were bad and showed only slight improvement. There was a great deal of overcrowding, and many families lived in condemned houses or in houses which would have been condemned long ago had it not been for the housing shortage. The medical officer of health has made great efforts in the last 28 years to provide adequate housing for families with a sputum-positive member. Unfortunately, owing to the great shortage of houses, he was able to secure the rehousing of only those families in which there were small children and in which there was overcrowding in the statutory sense. The standards of epidemiological need had to be set very strictly, and, even so, the rehousing of those most in need could often not be secured until after the children became infected. In the last seven years an annual average of 68 tuberculous families have been rehoused. This rate has slowed down in recent years, and the figure fell to 28 in 1952. This rehousing policy may well contribute to the maintenance of a moderately low basic level of tuberculosis mortality, but there is no evidence that the recent rapid drop was due to this factor. Further evidence that improvements in the social conditions were probably not of major importance in recent years is presented below.

Effect of Specific Treatment of Tuberculous Children

The third possible factor in the reduction of mortality is the more efficient treatment of tuberculous children and adults since the introduction of streptomycin and other new drugs and methods of treatment. Treatment of infected children may directly save lives, while the treatment of infectious adults may prevent tuberculous infection in children.

Of these last two factors the effect of treatment of the fatal forms of tuberculosis in children is much more obvious, and it is relatively easy to assess its role quantitatively. The beginning of the recent fall in mortality coincided with the advent of streptomycin at the end of 1947. In the five years from 1948 to 1952, of 45 Sheffield children treated in the Sheffield Children's Hospital for tuberculous meningitis or miliary tuberculosis 32 recovered; of over 20 other Sheffield children treated elsewhere for these condi-

TABLE IV.—*Annual Mortality Rate from Tuberculosis of Children aged 0-14 Years per 100,000 Living Children in England and Wales and in Their Major Cities*

Year	England and Wales	London (A.C.)	Birmingham	Liverpool	Manchester	Sheffield	Leeds	The Next 6 Cities*
1945	25	20	24	37	36	26	26	29
1946	22	25	20	30	27	24	18	23
1947	21	20	27	32	25	25	21	22
1948	17	15	23	30	21	17	15	20
1949	12	9	14	21	12	17	13	16
1950	9.4	6.0	8.7	20.0	10.1	10.5	8.2	11.7
1951	8.5	6.6	12.1	15.8	10.7	5.3	10.9	8.5
1952†		4.8	5.3	8.5	8.0	1.8	4.6	4.9

* Bristol, Nottingham, Kingston-upon-Hull, Bradford, Newcastle-upon-Tyne, Leicester.

† Provisional figures.

TABLE V.—*Annual Mortality Rate from Tuberculosis of Children Aged 0-14 Years per 100,000 Living Children in Scotland, Glasgow, and Edinburgh*

Year	Scotland	Glasgow	Edinburgh
1945	45	77	40
1946	46	75	38
1947	46	78	36
1948	32	56	36
1949	23	44	11
1950	18	38	11
1951	16	30.6	10
1952*	10	20.5	7.8

* Provisional

TABLE VI.—*Statistical Probability that the Differences Between Sheffield and other Cities are Due to Chance, Expressed in Percentages*

City	Child Population† (in Thousand)	Number of Child Deaths from Tuberculosis in 1951 and 1952	Probability %
London ..	660	74	17.2
Birmingham ..	260	46	0.4
Liverpool ..	210	50	0.1
Manchester ..	160	30	0.7
Sheffield ..	110	8	—
Leeds ..	110	17	7.2
Next 6 English cities combined*	450	58	6.8
Glasgow ..	260	136	<0.1
Edinburgh ..	100	18	3.0

* Bristol, Nottingham, Kingston-upon-Hull, Bradford, Newcastle-upon-Tyne, Leicester.

† 1951 Census figures.

these latter six the rates of Nottingham, Bristol, and Leicester were particularly favourable. In each of these major cities and in the two major cities of Scotland the mortality rate was reduced from three to five times between 1947 and 1952. In Sheffield the reduction was fourteenfold. In spite of great improvements, Glasgow's 1951 mortality rate of 20 per 100,000 was still eleven times higher than that of Sheffield (Table V). When the 1951 and 1952 death rates are combined the differences between Sheffield and most other major cities in Great Britain are statistically significant (Table VI).

Causes of Decline of Tuberculosis Mortality in Sheffield

It is now necessary to consider the various factors which might have been responsible for such a great decline in the tuberculosis mortality in children in the last five years

TABLE VII.—*Number of Children (0-14 Years) who Died of Tuberculosis and Who Were Successfully Treated for Fatal Forms of Tuberculosis. Sheffield, 1945-52*

Year	No. Died	No. Successfully Treated	Total
1934	29	—	29
1945	26	—	26
1946	25	S.M. —	25
1947	26	2	28
1948	18	5	23
1949	18	B.C.G. 7	25
1950	12	2	14
1951	6	10	16
1952	2	8	10

tions during the same period unfortunately only two survived. If one adds to the deaths from tuberculosis in each year the number of children who contracted tuberculous meningitis or miliary tuberculosis but survived, one obtains a close estimate of the minimum mortality which would have resulted without the use of streptomycin and the newer drugs (Table VII). It is apparent that the number of deaths in 1945 to 1949 and in the last six years before the war would have been strikingly similar. The fall in deaths in 1948 and 1949 was therefore apparently largely due to the streptomycin treatment of children suffering from meningitis and miliary tuberculosis. The figures from 1950 onwards suggest, however, additional factors of equal or greater importance.

Effect of Specific Treatment of Adults

One of these possible factors is the earlier diagnosis and the more effective treatment of tuberculous adults with streptomycin and other methods. It is difficult to assess quantitatively the exact role of this factor. Streptomycin undoubtedly reduced the mortality of adults and rendered more infectious cases sputum-negative more quickly, but it saved the lives of many advanced cases who live in a chronically sputum-positive state, possibly with resistant organisms and infecting others. The introduction of mass miniature radiography helped to detect active cases of tuberculosis at a relatively early stage of the disease. The fall in the tuberculosis mortality rate in adults in Sheffield to 46% of the 1947 figure already mentioned was, however, much less than that obtained in children (see Chart). It is of

Chart showing the reduction of tuberculosis deaths in adults (15 years+) and children (0-14 years) in Sheffield, 1947-52. Comparative mortality indices, 1947=100. *Provisional figures.

interest that the rate of reduction in adult mortality was strikingly similar in the six largest cities of England and Wales, including Sheffield, and in the two largest cities in Scotland. The rate of reduction of deaths in children exceeded that of adults everywhere. Whereas, however, the ratio of reduction in favour of children in the other major cities was two to one or less, in Sheffield it was 6.5 to one (Table VIII).

TABLE VIII.—Comparative Mortality Indices for Tuberculosis in Children and Adults for 1952. 1947=100

City	Adults	Children	Ratio A/C
London ..	46	24	1.9
Birmingham ..	43	20	2.1
Liverpool ..	52	27	1.9
Manchester ..	49	32	1.5
Sheffield ..	46	7	6.5
Leeds ..	35	22	1.6
Glasgow ..	49	25	2.0
Edinburgh ..	41	21	2.0

It seems, therefore, that so far the more efficient treatment of adults has played only a minor part in the reduction of child mortality in Sheffield. There is no doubt, however, that the ultimate eradication of tuberculosis in children will depend chiefly on the early diagnosis, quick segregation, and effective treatment of tuberculosis in adults, just as the prevention of tuberculosis in children will contribute to the disappearance of tuberculosis in adults.

Preventive Measures

Finally, we must consider the effect of preventive measures. Milk-borne infection played very little part in the tuberculosis mortality of Sheffield children after the war. Practically all milk consumed within the city was pasteurized, and over 95% of the cases of tuberculous meningitis treated in the Children's Hospital between 1947 and 1952 were due to the human type of organism.

Up till 1949, however, very few facilities were available for segregation of children living in tuberculous households. In the course of an investigation of the contact history of 150 cases of tuberculous meningitis and miliary tuberculosis (Lorber, 1950) it was suggested that a great deal more could be done to prevent tuberculosis in children and to diagnose tuberculosis earlier in those who had already contracted the disease. Early diagnosis of meningitis and of miliary tuberculosis promised a considerable saving of lives, especially in children under 3 years of age. Over a third of our cases of tuberculous meningitis belonged to this group, and diagnosis was more often delayed in babies than in older children.

Work of a Contact Clinic for Babies and Small Children

In 1949 we therefore approached Dr. Turner, the chest physician of Sheffield, and asked for co-operation in opening a contact clinic for the younger age groups, in which the mortality was highest. This was agreed to, and it was accordingly arranged that all children aged 2 years or under who were in contact with notified cases of tuberculosis should attend a contact clinic at the Children's Hospital. In 1952 this age limit was extended to include those between 2 and 3 years old at the time of their first examination. Most of the older children remained the chest physician's responsibility, but we cared for many who were referred directly to us. The chest physician sent us periodically a list of children, giving brief details of the nature of contact, and it was our responsibility to call upon, examine, and look after these children. The chest physician also allowed us access to the records of the chest clinic, to ensure fuller co-operation in the service. Dr. Llywelyn Roberts, the medical officer of health for Sheffield, has given us great support by kindly allowing us to use the services of the city health visitors.

The organization of the clinic was as follows. The parents were sent a preliminary letter asking them to bring their child for examination at the Children's Hospital and giving the reason for this. They were also informed that a health visitor would call on them four days before their hospital appointment to explain the position in more detail and to apply a skin test. These arrangements were set in motion immediately we received a notification, so that all children were offered an appointment within a week. The health visitor then applied the tuberculin-jelly test and gave appropriate instructions. She also visited, as often as necessary, all those who failed to keep their appointments. From 1952 onwards a research assistant called at the houses of persistent absentees so that no child should miss a medical examination and so that continuity of supervision should be ensured. The family doctor was fully informed of the circumstances of the child's attendance and of our findings. We discussed with him our plans for the child's management, and told him about subsequent developments. In the case of tuberculous children, he was reminded of the possible serious significance of relatively trivial symptoms, which might mean the beginning of meningitis. The first

clinic was held in July, 1949, and up to the end of 1952 some 550 young children had attended at least once.

In the case of tuberculin-negative infants (the largest group) importance was attached to the instruction of parents in the methods of preventing infection when contact was inevitable. Immediate separation from contact, however, could usually be arranged. The index case was often already in a sanatorium or was just about to be admitted. In other cases permanent separation was possible without breaking up the family. In yet others, temporary separation could be arranged with their own relations. If this was not possible the infants were admitted to a small private nursery at the cost of the public health authority.

When B.C.G. became available vaccinations were started on the first possible day—October 6, 1949. By the end of 1952 we had vaccinated over 300 tuberculin-negative infants, including those born at the Jessop Hospital for Women who were in potential future contact with known cases of tuberculosis. Babies born of tuberculous mothers at the hospitals of the regional board were vaccinated by the chest physician, as were most of the older children. Up to the end of 1952 1,164 Sheffield children had been vaccinated—a relatively small number, representing 1% of Sheffield's child population of 110,000.

Separation from contact from active cases of tuberculosis was insisted upon for at least six weeks before vaccination, and again until tuberculin conversion had taken place. Separation is important if B.C.G. vaccination is not to fall into disrepute. One Sheffield boy who was vaccinated elsewhere without separation from contact developed tuberculosis of a hip-joint and pulmonary tuberculosis.

Babies and small children to the number of 104, or less than one-fifth of the total who attended, were already tuberculin-positive at their first visit or were converted spontaneously before protective measures could be taken. The management of these children was strictly conservative. Once they were infected it was not thought necessary to separate them from contact. They were cared for throughout as out-patients, unless illness or social reasons necessitated temporary admission to hospital. Everything possible was done to ensure the children's adequate nutrition, vitamin intake, and home care, and we provided financial help, bedding, and other services. When it was felt to be safe, usually after one year of observation, the children were sent away for long holidays by the seaside or in the country. Streptomycin was not used, except in those who developed tuberculous meningitis or miliary tuberculosis, and the results appear to justify this policy. In spite of the very young age at which these babies contracted tuberculosis, only a single child died of tuberculosis* in four years, and his death should have been prevented. This tuberculous infant had a short episode of irritability with vomiting. He was admitted, and his cerebrospinal fluid showed minimal deviation from normal, consistent with "serous tuberculous meningitis." He made a rapid spontaneous symptomatic recovery and the C.S.F. returned to normal in a few days. He remained well for four months, but then headache and vomiting recurred. His own doctor advised against taking him to hospital, "to save the child an unnecessary lumbar puncture." Several days later he developed an uncontrollable status epilepticus and died shortly after arrival in hospital, death being due to advanced tuberculous meningitis.

Effect of Earlier Diagnosis of Tuberculous Meningitis

Six other babies with primary tuberculosis who attended the clinic developed tuberculous meningitis while under observation. All were diagnosed within 24 hours of their first symptoms and all made a good recovery with streptomycin treatment. Another child developed miliary tuberculosis and is making satisfactory progress.

During the three years from 1949 to 1951 we treated 78 children suffering from tuberculous meningitis in the depart-

ment of child health. Of our patients 60 came from outside Sheffield, and of these 25, or about two-fifths, survived, while of the 18 Sheffield children 14, or three-quarters, recovered, with a minimum period of observation of 23 months from the beginning of treatment. The better results in Sheffield children may be attributed to the earlier diagnosis of tuberculous meningitis, which we think was helped by the contact clinic and the intimate knowledge gained of the tuberculous babies of the city.

Discussion

Even if streptomycin had not been available for the treatment of tuberculous meningitis and miliary tuberculosis and all 10 Sheffield children who in 1952 developed these conditions had died, the death rate would have been only 9 per 100,000, compared with a rate of 25 per 100,000 in 1947. This hypothetical death rate is almost the same as was the actual death rate in two large neighbouring cities and in the whole of Scotland in 1952 and in England and Wales in 1951. These figures indicate the progress of the preventive aspects of the work in the last few years. Between 1947 and 1950 the rate of reduction of child mortality from tuberculosis was very similar in England and Wales, in Scotland, and in the eight major cities, including Sheffield. Since then the rate of reduction has slowed down, except in Sheffield, when it was accelerated (Table IX). In Scot-

TABLE IX.—Comparative Mortality Indices for Tuberculosis in Children for 1950 and 1952. 1947=100

	1950	1952
England and Wales	45	—
Scotland	39	22
London	30	24
Birmingham	35	20
Liverpool	64	27
Manchester	41	32
Sheffield	46	7
Leeds	41	22
Glasgow	45	25
Edinburgh	29	21

land, London, Birmingham, Manchester, Leeds, Glasgow, and Edinburgh the mortality rate in 1952 was over one-half of the 1950 figure; in Liverpool it was two-fifths, and in Sheffield only one-sixth.

Unfortunately, because of the vagaries of notifications, it is impossible to obtain accurate and comparable figures of tuberculosis morbidity in children. In Sheffield there has been a growing tendency to discover and notify an increasing proportion of the tuberculous children. In the five years from 1947 to 1951 inclusive an average of 240 children were notified (range 226 to 253), but in 1952 this number fell by one-third to 163, providing some further evidence of the success of the preventive measures, and also indicating that there is much room for further improvement.

It is not possible to state just how much each measure contributed to the fall in tuberculosis mortality in Sheffield children. It appears probable that B.C.G. vaccination of susceptible contacts was a factor, because not one of them has developed clinically or radiologically detectable tuberculosis so far, and none have died, although they were all allowed to resume contact after successful conversion. It is of interest that such a relatively small number of vaccinations, involving only 1% of the child population in 3½ years, could be effective, because it appears that most of those in need were actually vaccinated. These findings suggest that by the earliest possible examination of susceptible child contacts, their quick segregation, and their subsequent vaccination, further reduction of morbidity and mortality can be anticipated, and that mass B.C.G. vaccination of small children may not be necessary under the conditions at present prevailing in this country.

It would be unwise to attach too much importance to the specially low figures obtained in 1952, unless they are regularly repeated, or even improved upon, in subsequent

*Another child died of bulbar poliomyelitis. This diagnosis was confirmed at necropsy.

years. Nevertheless, the trend of mortality has been so consistently downward in the last five years that, subject to increasing vigilance, one may reasonably hope for further progress in this sphere. In the first half of 1953 only one Sheffield child died of tuberculosis. A careful examination of the local situation leads one to conclude that complete eradication of tuberculosis mortality in children is possible in the near future, and that any deterioration could only be the direct result of relaxation of our efforts.

There is yet much to be done in the field of tuberculosis prevention. In our experience the first and basic necessity is the acquisition of a sense of urgency by all those who deal with any aspect of tuberculosis. This is a difficult task when confronted with a disease which is always with us and the progress of which is usually measured in months and not days. A few weeks' delay in contact examination and in arranging for the segregation of infectious cases may greatly diminish the efficiency of the preventive services and of a B.C.G. vaccination programme, because the contacts of the most infectious cases will already have contracted tuberculosis before adequate steps can be taken to protect them. Complacency is our greatest enemy.

Meanwhile, with reasonably early diagnosis of tuberculous meningitis and of miliary tuberculosis, and with adequate treatment, most patients should now be saved. Of 20 patients suffering from tuberculous meningitis who were admitted from a wide area to the department of child health during 1951 and who were conscious on admission, 18 survived, with a minimum period of observation of 21 months. Out of 14 cases of uncomplicated miliary tuberculosis in children under our care after 1947 none has died. These cases must be treated as medical emergencies in a fully equipped centre. Had this been done in the case of the two deaths in 1952 these deaths might not have occurred.

It is not the purpose of this paper to discuss in detail the principles of the prevention of tuberculosis. These are well known, and much lip service is paid to them. Nevertheless everyday experience shows serious gaps in the application of these principles. Lack of hospital beds and shortage of nurses for the care of tuberculous adults are only part of the trouble, which requires urgent remedies on a national level. Case-finding methods could be further intensified. In this respect it is regrettable that a positive tuberculin reaction in a small child is not admissible for notification if this is the only evidence of his disease. This regulation deprives the chest physician of an excellent case-finding method. Contact examinations should be extended beyond the immediate household.

Education of the general public and of tuberculous patients is still far from adequate, and there is much complacency regarding the supposed lack of infectivity of sputum-negative cases. It is only in the application of the fundamental principles of tuberculosis control that the eventual eradication of this disease will be possible. Meanwhile, the judicious use of B.C.G. for susceptible contacts and the skilful treatment of tuberculous children should lead to the elimination of deaths from tuberculosis in children. Our experience suggests that this may be best achieved by the intimate co-operation of the paediatric services with the chest clinic and the public health authorities.

Sources of Information.—The data on which this paper is based were obtained from the Annual Reports of the Registrar-General of England and Wales and from the Registrar-General's personal communications for 1951 and 1952; from information obtained from the Chief Medical Officer of Health for Scotland and from the medical officers of health of those cities for which statistics are here provided; and from the records of the Chest Clinic, Sheffield. Death rates for 1951 were calculated on the basis of the provisional estimates of population in the 1951 Census and for other years on intercensal estimates. As the previous census was held 20 years ago, and as the war caused great dislocation of the population, these estimates are subject to error, but not sufficient to affect appreciably the calculated mortality

rates. Any degree of error so introduced would apply to all areas in the same way. For the reason of this possible error, however, the absolute number of deaths was used for the various calculations wherever possible.

Summary

The tuberculosis mortality figures of Sheffield children for the last 30 years are presented. The number of annual deaths did not fall between 1934 and 1947, but after that the death rate dropped 14-fold in five years—from 25 in 1947 to 1.8 per 100,000 in 1952. In 1952 only two Sheffield children died of tuberculosis. This decline of tuberculosis mortality in children far exceeded that in adults and also the decline of mortality in children from all other causes.

In Great Britain as a whole, as well as in all her other major cities, the fall was considerable during the same period, but was less than fivefold everywhere except in Sheffield. The tuberculosis mortality rates for 1951 and 1952 in Sheffield were better than in any other major city in the country.

The possible causes for the recent rapid improvement in Sheffield are discussed and analysed. It is shown that the successful treatment of otherwise fatal forms of tuberculosis in children since streptomycin became available was responsible for this improvement up to and including 1949. Since 1950, preventive measures—namely, intensified contact examinations, segregation, and B.C.G. vaccination of children in tuberculous families and households—may have been as important as streptomycin treatment in the progressive reduction in mortality. In this connexion the work of a tuberculosis contact clinic for small children has been outlined.

Further reduction of tuberculosis morbidity, and the eradication of tuberculosis mortality, are believed to be possible with increasing effort and vigilance. The fundamental methods of tuberculosis control, assisted by B.C.G. vaccination and the effective chemotherapy of the otherwise fatal forms of tuberculosis in children, should quickly lead to the elimination of deaths from this cause in children.

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